EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	feedforward and "6728324".pn.	USPAT	OR	ON	2006/03/24 21:38
L2	1321	((feedforward (feed adj forward)) same (feedback (feed adj back))) same (filter equalizer)	USPAT	OR	ON	2006/03/24 21:40
L3	5	2 same chip same slic$4	USPAT	OR	ON	2006/03/24 21:41
L4	21	2 same chip same (slic$4 decision)	USPAT	OR	ON	2006/03/24 21:56
L5	1	"6690715".pn. and fir	USPAT	OR	ON	2006/03/24 22:00
L6	0	"6690715".pn. and mmse	USPAT	OR	ON	2006/03/24 22:11
L7	1	"6690715".pn. and error	USPAT	OR	ON	2006/03/24 22:02
L8	1	"6690715".pn. and chip	USPAT	OR	ON	2006/03/24 22:02
L9	1	"6678310".pn. and mmse	USPAT	OR	ON	2006/03/24 22:19
L10	1812	375/130.ccls. 375/229.ccls. 375/233.ccls.	USPAT	OR	ON	2006/03/24 22:20
L11	701	chip and 10	USPAT	OR	ON	2006/03/24 22:20
L12	127	fir and 11	USPAT	OR	ON	2006/03/24 22:20
S1	2	"5602583".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:51
S2	2	"5579335".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:54
S3	5	"2003006173".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:54
S4	5	"2003008173".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 09:55
S5	2	"20030081703".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25
S6	2	"6956564".pn.	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25
S7	0	ink and S6	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/23 10:25

EAST Search History

S8	10578	(feedback (feed adj back)) near2 (filter$4 equali$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 11:59
S9	152198	slic$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 11:59
S10	2205	chip near3 S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 12:00
S11	19	S8 and S10	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	ON	2006/03/24 12:00
S12	0	("2004/0240538").URPN.	USPAT	OR	ON	2006/03/24 17:57
S13	1	"6337878".pn.	USPAT	OR	ON	2006/03/24 17:57
S14	1	chip and S13	USPAT	OR	ON	2006/03/24 21:37

US-PAT-NO: 6728324

DOCUMENT-IDENTIFIER: US 6728324 B1

TITLE: Method and apparatus for multipath signal compensation in spread-spectrum communications systems

---

Detailed Description Text - DETX (59):

The input signal u(t) represents the output from the carrier recovery circuit 120. The signal u(t) comprises multi-bit complex values (real and imaginary) representing discrete, synchronized samples of the received signal taken at chip or sub-chip resolution. The u(t) samples include multipath interference. The equalizer 130 provides multipath interference cancellation based on applying hard-decision logic to the actual phase value of each input sample of u(t) (chip or sub**-chip) to form a sliced** sample, or hard-decision value. Preferably, a given input sample is compensated for post-cursor secondary signal interference before hard-slicing, but other embodiments of the equalizer 130 may perform hard slicing before or after pre- or post-cursor compensation. For example, in DSSS using QPSK, or in 802.11b payload data using CCK, each received symbol or chip takes a symbol value on a QPSK constellation, and the hard-decision may be made by hard-slicing the phase of the received sample in u(t). To cancel post-cursor multipath interference, the hard**-sliced chip** (or sub-chip) decision(s) is fed back with the proper delay(s) (e.g., .tau..sub.1i) and multiplicand coefficient(s) (e.g., C.sub.1i) for subtraction from u(t) in summing node 302. This aspect of operation is conceptually similar to more conventional Decision **Feedback Equalizers** (DFE), which are well understood in the art.

US-PAT-NO: 6678310

DOCUMENT-IDENTIFIER: US 6678310 B1

TITLE: Wireless local area network spread spectrum transceiver with multipath mitigation

---

US Patent No. - PN (1):

6678310

Detailed Description Text - DETX (139):

Decision feedback equalizers are usually trained using either a zero-forcing metric (ZF) or a minimum-mean-squared-error metric (**MMSE**) as known to those skilled in the art. Most textbooks describe the use of a training sequence with either a slow recursive algorithm (LMS) or a fast recursive algorithm (RLS). Alternatively, for the wireless world, techniques have been developed for instant training using a estimate of the channel impulse response. A preamble (IS-54) or a midamble (GSM) is used with impulsive autocorrelation properties for performing the channel estimation. The channel impulse response can be used to calculate the DFE taps.

US006678310B1

(12) **United States Patent**
Andren et al.

(10) **Patent No.: US 6,678,310 B1**
(45) **Date of Patent: Jan. 13, 2004**

(54) **WIRELESS LOCAL AREA NETWORK SPREAD SPECTRUM TRANSCEIVER WITH MULTIPATH MITIGATION**

(75) Inventors: **Carl Andren**, Indialantic, FL (US); **Mark A. Webster**, Palm Bay, FL (US)

(73) Assignee: **Intersil Americas Inc**, Milpitas, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/231,184**

(22) Filed: **Jan. 14, 1999**

Related U.S. Application Data

(60) Provisional application No. 60/071,659, filed on Jan. 16, 1998.

(51) **Int. Cl.**^{7} **H04B 1/69**

(52) **U.S. Cl.** **375/147**

(58) **Field of Search** 375/130, 133, 375/135, 136, 137, 140, 141, 142, 144, 150, 219, 224, 229, 230, 232, 233, 295, 316, 329, 346, 349, 147

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,346,473 A	8/1982	Davis	371/43
4,545,054 A	10/1985	Davis	371/43
4,626,796 A	12/1986	Elder	331/1 A
5,103,459 A	4/1992	Gilhousen et al.	375/1
5,216,434 A	6/1993	Fukumura	343/876
5,309,474 A	5/1994	Gilhousen et al.	375/1
5,367,516 A	11/1994	Miller	370/19
5,369,801 A	11/1994	Smith	455/277
5,416,797 A	5/1995	Gilhousen et al.	375/705
5,497,395 A	3/1996	Jou	375/205
5,515,396 A	5/1996	Dalekotzin	375/206
5,530,926 A	6/1996	Rozanski	455/277.2
5,535,239 A	7/1996	Padovani et al.	375/205
5,577,025 A	11/1996	Skinner et al.	370/22
5,598,154 A	1/1997	Wilson et al.	341/50

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

EP	0 755 141 A2	2/1997	H04L/25/03
WO	WO 97/36396	10/1997	H04L/7/04
WO	WO 97/37437	10/1997	H04B/1/707

OTHER PUBLICATIONS

Harris Corporation Application Note entitled, "Harris PRISM Chip Set," No. AN9614, Mar. 1996.

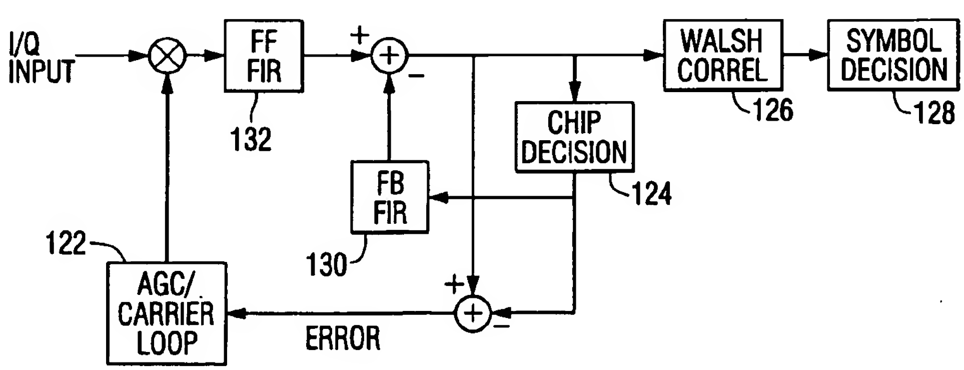
(List continued on next page.)

Primary Examiner—Mohammad H. Ghayour
Assistant Examiner—Pankaj Kumar
(74) *Attorney, Agent, or Firm*—Gary R Stanford

(57) **ABSTRACT**

A demodulator used in a base band processor of the spread spectrum radio transceiver includes a demodulator circuit for spread spectrum phase shift keying (PSK) demodulating an information signal received from a radio circuit. The information signal includes data symbols formed from a plurality of high rate mode chips forming a spread spectrum information signal. At least one predetermined code function correlator is in line with a signal input for decoding the information signal according to a predetermined code. A carrier loop circuit allows phase and frequency tracking of the information signal and a chip decision circuit is operative with the carrier loop circuit for tracking high rate mode chips. A decision feedback equalizer formed from a feedback finite impulse response filter is operative with the chip decision circuit and the carrier loop circuit. It has a plurality of feedback taps. At least one feedback tap is selected for logical add/subtract operations to aid in canceling multipath signal echoes. A feed forward finite impulse response filter can also be positioned in line to the code function correlator and the signal input and has a plurality of feed forward taps that are selected for logical multiply operations to aid in reducing multipath signal echoes. A method aspect of the invention is also disclosed.

22 Claims, 34 Drawing Sheets



ARCHITECTURE INCLUDING FEEDFORWARD DFE TAPS

US-PAT-NO: 6990158

DOCUMENT-IDENTIFIER: US 6990158 B2

TITLE: Method and apparatus for multipath signal compensation in spread-spectrum communications systems

---

Description Paragraph - DETX (74):

The input signal u(t) represents the output from the carrier recovery circuit 120. The signal u(t) comprises multi-bit complex values (real and imaginary) representing discrete, synchronized samples of the received signal taken at chip or sub-chip resolution. The u(t) samples include multipath interference. The equalizer 130 provides multipath interference cancellation based on applying hard-decision logic to the actual phase value of each input sample of u(t) (chip or sub**-chip) to form a sliced** sample, or hard-decision value. Preferably, a given input sample is compensated for post-cursor secondary signal interference before hard-slicing, but other embodiments of the equalizer 130 may perform hard slicing before or after pre- or post-cursor compensation. For example, in DSSS using QPSK, or in 802.11b payload data using CCK, each received symbol or chip takes a symbol value on a QPSK constellation, and the hard-decision may be made by hard-slicing the phase of the received sample in u(t). To cancel post-cursor multipath interference, the hard**-sliced chip** (or sub-chip) decision(s) is fed back with the proper delay(s) (e.g., .tau..sub.1i) and multiplicand coefficient(s) (e.g., C.sub.1i) for subtraction from u(t) in summing node 302. This aspect of operation is conceptually similar to more conventional Decision **Feedback Equalizers** (DFE), which are well understood in the art.